

## PATENT ABSTRACTS OF JAPAN

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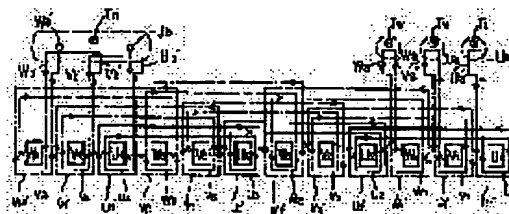
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## (54) WINDING METHOD OF ARMATURE COIL FOR ELECTRIC ROTATING MACHINE

## (57)Abstract:

**PURPOSE:** To obtain a winding method of armature coil for electric rotating machine in which a polyphase armature coil, comprising two coils being connected in parallel with each other for each phase, can be wound efficiently.

**CONSTITUTION:** In a step for winding the armature coil of phase U comprising first and second coils, unit coils u4, u3, u2, u1 are wound sequentially, at first, around the pole parts U4, U3, U2, U1 assigned to phase U along a predetermined slot starting from the end part Ub of the armature coil on the neutral side to produce the first coil for phase U wound up to the end part Ua on the nonneutral side. The second coil for phase U is then wound up to the end part Ub' on the neutral side by winding unit coils u1'-u4' sequentially in reverse direction along the slot being set with the first coil. Other armature coils are wound similarly and continuously without disconnecting the coil conductor on the way.



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CLAIMS

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[Claim(s)]

[Claim 1] Open spacing in a hoop direction and the magnetic pole section of a large number which have two or more magnetic pole sections assigned to each phase every is prepared in it. The armature core used as the slot for insertion is used. the slot formed between [ of these large number ] the magnetic pole sections, respectively — a coil — a conductor — By repeating the process which winds a unit coil around two or more magnetic pole sections assigned to each phase one by one, and constitutes the armature coil of each phase It is the armature coil winding approach of the dynamo-electric machine which winds the armature coil of the polyphase by which star connection is carried out. At the process which shall constitute the armature coil of each phase with the 1st coil and 2nd coil which are connected to juxtaposition, and constitutes the armature coil of each phase After performing the process which winds a unit coil around two or more magnetic pole sections assigned to each phase one by one, and winds the 1st coil of each phase to the edge by the side of the non-neutral point, following a predetermined slot by using the edge by the side of the neutral point of the armature coil of each phase as a cut-water edge, a coil — the armature coil winding approach of the dynamo-electric machine characterized by performing the process which winds a unit coil one by one and winds the 2nd coil of each phase to the edge by the side of the neutral point while following conversely the slot followed when winding this 1st coil, without cutting a conductor.

[Claim 2] Open spacing in a hoop direction and the magnetic pole section of a large number which have two or more magnetic pole sections assigned to each phase every is prepared in it. The armature core used as the slot for insertion is used. the slot formed between [ of these large number ] the magnetic pole sections, respectively — a coil — a conductor — By repeating the process which winds a unit coil around two or more magnetic pole sections assigned to each phase one by one, and constitutes the armature coil of each phase It is the armature coil winding approach of the dynamo-electric machine which winds the armature coil of the polyphase by which star connection is carried out. At the process which shall constitute the armature coil of each phase with the 1st coil and 2nd coil which are connected to juxtaposition, and constitutes the armature coil of each phase After performing the process which winds the 1st coil of each phase to the edge by the side of the non-neutral point by winding a unit coil around two or more magnetic pole sections assigned to each phase one by one, following a predetermined slot by using the edge by the side of the neutral point of the armature coil of each phase as a cut-water edge, The process which winds a unit coil one by one and winds the 2nd coil of each phase to the edge by the side of the neutral point while following conversely the slot followed when winding this 1st coil, without cutting a conductor is performed. a coil — By shifting to the process which winds the 1st coil of the armature coil of the following phase, after performing the process which winds the 2nd coil of the armature coil of each phase a coil — a conductor — on the way — the armature coil winding approach of the dynamo-electric machine characterized by winding the armature coil of all phases continuously, without coming out and cutting.

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## DETAILED DESCRIPTION

## [Detailed Description of the Invention]

[0001]

[Industrial Application] This invention relates to the approach of winding the armature coil of the polyphase of dynamo-electric machines, such as a motor and a generator.

[0002]

[Description of the Prior Art] The armature coil of the polyphase of dynamo-electric machines, such as a motor and a generator The armature core used as the slot for insertion is used. the slot which opened spacing in the hoop direction, prepared the magnetic pole section of a large number which have two or more magnetic pole sections assigned to each phase every in it, and was formed between [ of these large number ] the magnetic pole sections, respectively — a coil — a conductor — He is trying to wind the armature coil of the polyphase by which star connection is carried out by repeating the process which winds a unit coil around two or more magnetic pole sections assigned to each phase one by one, and constitutes the armature coil of each phase. and the coil into a slot — in order to do insertion of a conductor and the winding activity of a coil easy, let the armature coils of each phase be 2 juxtaposition volumes divided and wound around the 1st coil and 2nd coil which are connected to juxtaposition in many cases.

[0003] Drawing 4 and drawing 5 are what showed the conventional winding approach adopted when this kind by which three-phase-circuit star connection is carried out of armature coil was wound, drawing 4 is the coil development view of an armature coil, and drawing 5 is schematics. these drawings — setting — U1 -U4 and V1 -V4 And W1 -W4 the magnetic pole section of the armature core assigned to U phase, V phase, and W phase, respectively — it is — between [ these ] the magnetic pole sections — a coil — a conductor — the slot for insertion is formed. The non-neutral point side edge child Tu of U and V which consist of a pin fixed to the armature core in the condition of having insulated for example, to this iron core, and W phase, Tv, and Tw Neutral point side edge child Tn It is prepared. In addition, in drawing 4 and drawing 5 , it means that the part of each other surrounded with the broken line is connected electrically.

[0004] the process which winds the armature coil of U phase — first — a coil — the cut-water edge Ua of a conductor — non-neutral point side edge child Tu of U phase After twisting the magnetic pole section U1, U2, and U3 U4 [ and ] — one by one — the unit coil u1, u2, and u3 And u4 the direction of an illustration arrow head — meeting — continuing — winding — winding — end edge Ub Neutral point side edge child Tn A conductor is cut. the coil after twisting — Unit coil u1-u2-u3-u4 The 1st coil of U phase is constituted. Next, he is the same non-neutral point side edge child Tu about cut-water edge Ua '. Following the slot followed when winding the 1st coil, after twisting one by one the magnetic pole section U1, U2, and U3 And U4 2nd coil u1'-u2'-u3'-u4 ' — winding — winding — end edge Ub ' — neutral point side edge child Tn the coil after twisting — a conductor is cut.

[0005] By repeating a process with the same said of V phase and W phase, the armature coil of V phase and W phase is wound, respectively. That is, about V phase, the cut-water edge Va and Va ' are the non-neutral point side edge child Tv. It is twisted. the magnetic pole section V1, V2, and V3 V4 [ and ] — the 1st coil v1-v2-v3-v4 and 2nd coil v1'-v2'-v3'-v4 ' winds — having — each — winding — the end edge Vb and Vb ' — neutral point side edge child Tn It is twisted. Moreover, about W phase, the cut-water edge Wa and Wa ' are the non-neutral point side edge child Tw. It is twisted. the magnetic pole section W1, W2, and W3 And W4 The 1st coil w1-w2-w3-w4 and 2nd coil w1'-w2'-w3'-w4 ' winds, respectively — having — winding — the end edge Wb and Wb ' — neutral point side edge child Tn It is twisted.

[0006]

[Problem(s) to be Solved by the Invention] the conventional winding approach which winds the armature coil of the polyphase of a configuration of having carried out star connection of the armature coil of each phase which consists of the 1st coil and 2nd coil each other connected to juxtaposition — each cut-water edge and process which winds and twists an end edge around a non-neutral point side edge child and a neutral point side edge child, respectively of the 1st coil of each phase, and the 2nd coil, and each end edge of a volume — a coil — the process which cuts a conductor is required For example, to wind the armature coil by which three-phase-circuit star connection is carried out as mentioned above, it is necessary to perform six cutting about the edge of the 1st coil and the 2nd coil as a total of 12 times should coil. Therefore, by the conventional armature coil winding approach, the working hours of a coil started for a long time, and there was a problem that the cost of an armature coil became high.

[0007] the purpose of this invention — the terminal of a coil end — twisting — the count of activation of a process, and a coil — it is in offering the armature coil winding approach of a dynamo-electric machine of lessening the

count of activation of the cutting process of a conductor, and having enabled it to often do a winding activity.

[0008]

[Means for Solving the Problem] This invention opens spacing in a hoop direction, and prepares the magnetic pole section of a large number which have two or more magnetic pole sections assigned to each phase every in it. The armature core used as the slot for insertion is used. the slot formed between [ of these large number ] the magnetic pole sections, respectively — a coil — a conductor — By repeating the process which winds a unit coil around two or more magnetic pole sections assigned to each phase one by one, and constitutes the armature coil of each phase The armature coil of each phase shall be constituted by the 1st coil and 2nd coil which are connected to juxtaposition with respect to the armature coil winding approach of the dynamo-electric machine which winds the armature coil of the polyphase by which star connection is carried out.

[0009] In this invention, are the process which constitutes the armature coil of each phase, and the edge by the side of the neutral point of the armature coil of each phase is used as a cut-water edge. After performing the process which winds a unit coil around two or more magnetic pole sections assigned to each phase one by one, and winds the 1st coil of each phase to the edge by the side of the non-neutral point, following a predetermined slot, a coil — the slot followed when winding this 1st coil, without cutting a conductor — reverse — etc. — by performing the process which winds a unit coil one by one with \*\*, and winds the 2nd coil of each phase to the edge by the side of the neutral point on the way — coming out — a coil — the armature coil of each phase is wound continuously, without cutting a conductor.

[0010] the coil after performing the process which winds the 2nd coil of the armature coil of each phase according to the above-mentioned process in this invention again — shifting to the process which winds the 1st coil of the armature coil of the following phase, without cutting a conductor — a coil — a conductor — on the way — the armature coil of all phases is wound continuously, without coming out and cutting.

[0011]

[Function] As mentioned above, after performing the stroke which begins to roll the armature coil of each phase from the edge by the side of the neutral point of the 1st coil, and winds it to the edge by the side of the non-neutral point, a coil, if it shifts to the winding process of the 2nd coil as it is and this 2nd coil is wound to the edge by the side of the neutral point, without cutting a conductor the time of shifting to the process which winds the 2nd coil from the process which winds the 1st coil — a coil — it not only becoming unnecessary to perform the process which cuts a conductor but the edge by the side of the non-neutral point of the 1st coil and the 2nd coil — a coil — a conductor is connectable common to this terminal only by twisting around a non-neutral point side edge child once.

[0012] moreover, the coil after performing the process which winds the 2nd coil of the armature coil of each phase, if it is made to shift to the process which winds the 1st coil of the armature coil of the following phase, without cutting a conductor on the way — coming out — a coil — it not only can wind the armature coil of all phases, but, without cutting a conductor It is connectable only by twisting the edge by the side of the neutral point of the 2nd coil of the armature coil of each phase, and the edge by the side of the neutral point of the 1st coil of the armature coil of the following phase around a neutral point side edge child once.

[0013] thus — according to this invention — a coil — the count of the process which cuts a conductor, and a coil — since the count of the process which twists a conductor around a terminal can be lessened, the time amount which winding of an armature coil takes can be shortened.

[0014]

[Example] Drawing 1 and drawing 2 are what showed the example of this invention, and a coil development view when drawing 1 applies the winding approach of this invention to the armature coil by which three-phase-circuit star connection is carried out, and drawing 2 are the schematics. In these drawings, the same sign shall be given to the part equivalent to drawing 3 and drawing 4 , and it shall mean that the part of each other enclosed with a broken line is connected electrically.

[0015] In drawing 1 and drawing 2 , connection of the armature coil of the three phase circuit of U phase, V phase, and W phase is carried out to stellate. magnetic pole section U1 -U4 by which the armature coil of U phase was assigned to U phase of an armature core Unit coil u1 -u4 wound, respectively from — with the 1st becoming coil The magnetic pole section U1 -U4 [ same ] It is constituted by the 2nd coil which consists of another unit coil u1 ' wound, respectively - u4 '. The armature coil of V phase magnetic pole section V1 -V4 assigned to V phase Unit coil v1 -v4 wound, respectively from — the magnetic pole section V1 -V4 [ same ] as the 1st becoming coil It is constituted by the 2nd coil which consists of another unit coil v1 ' wound, respectively - v4 '. magnetic pole section W1 -W4 [ moreover, ] by which the armature coil of W phase was assigned to W phase Unit coil w1 -w4 wound, respectively from — the magnetic pole section W1 -W4 [ same ] as the 1st becoming coil It is constituted by the 2nd coil which consists of another unit coil w1 ' wound, respectively - w4 '. the magnetic pole section assigned to each phase of an armature core — U1, V1, W1, and U — 2, V2 and W2, U3, V3, W3, U4, V4, and W4 the slot which has been arranged so that regular intervals may be opened in a hoop direction and it may rank with it in order, and was formed between [ these ] the magnetic pole sections, respectively — a coil — a conductor — it is used as a slot for insertion.

[0016] By the winding approach of this example, it is the edge Ub by the side of the neutral point of the 1st coil of the armature coil of U phase first. Neutral point side edge child Tn It twists and is the edge Ub by the side of this neutral point. It considers as a cut-water edge. the magnetic pole section U4 assigned to U phase while following the predetermined slot along the direction of an arrow head of illustration, U3, and U2 And U1 one by one — the

unit coil u4 and u3 u2 And u1 winding — the 1st coil of U phase — edge Ua by the side of the non-neutral point The process to wind is performed. up to — edge Ua by the side of this non-neutral point a coil — a conductor — non-neutral point side edge child Tu It twists. It turns up without cutting a conductor. after that — the non-neutral point side edge section — a coil — Following conversely the slot followed when making the turned-up part into cut-water edge Ua ' of the 2nd coil and winding the 1st coil The magnetic pole section U1 of U phase, U2, and U3 And the process which winds unit coil u1 ', u2 ', u3 ', and u4 ' around U4 one by one, and winds the 2nd coil of U phase to edge Ub ' by the side of the neutral point is performed. the coil of this neutral point side edge section Ub' — a conductor — neutral point side edge child Tn It twists. Coil u1 ~u4 of these 1st 2nd coil u1 ' - u4 ' constitute the armature coil of U phase.

[0017] the coil after finishing the process which winds the 2nd coil of the armature coil of U phase — it shifts to the process which winds the 1st coil of the armature coil of the following V phase continuously, without cutting a conductor. In the stroke which winds the 1st coil of the armature coil of V phase It is the cut-water edge Vb about the part turned up from edge Ub ' by the side of the neutral point of the armature coil of U phase. It carries out. the magnetic pole section V4 assigned to V phase while following the predetermined slot, V3, and V2 And V1 one by one — the unit coil v4, v3, and v2 And v1 winding — the 1st coil of V phase — edge Va by the side of the non-neutral point up to, after performing the process to wind this non-neutral point side edge section Va a coil — a conductor — non-neutral point side edge child Tv It twists. then, a coil — the slot followed when making into cut-water edge Va ' of the 2nd coil the part turned up and turned up and winding the 1st coil, without cutting a conductor — reverse — etc. — with \*\* The magnetic pole section V1 of V phase, V2, and V3 And V4 After performing the process which winds unit coil v1 ', v2 ', v3 ', and v4 ' one by one, and winds the 2nd coil of the armature coil of V phase to edge Vb ' by the side of the neutral point, the coil of this neutral point side edge section Vb ' — a conductor — terminal Tn by the side of the neutral point It twists. Coil v1 ~v4 of these 1st And 2nd coil v1 ' - v4 ' constitute the armature coil of V phase.

[0018] the coil after finishing the process which winds the 2nd coil of the armature coil of V phase — it shifts to the process which winds the 1st coil of the armature coil of the following W phase continuously, without cutting a conductor. In the stroke which winds the 1st coil of the armature coil of W phase It is the cut-water edge Wb about the part turned up from neutral point side edge section Vb ' of the armature coil of V phase. It carries out. the magnetic pole section W4 assigned to W phase while following the predetermined slot, W3, and W2 And W1 one by one — the unit coil w4, w3, and w2 And w1 winding — the 1st coil of W phase — edge Wa by the side of the non-neutral point up to, after performing the process to wind this edge Wa a coil — a conductor — non-neutral point side edge child Tw It twists. then, a coil, following conversely the slot followed when making into cut-water edge Wa ' the part turned up and turned up and winding the 1st coil, without cutting a conductor The magnetic pole section W1 of W phase, W2, and W3 And W4 After performing the process which winds unit coil w1 ', w2 ', w3 ', and w4 ' one by one, and winds the 2nd coil of the armature coil of W phase to edge wb ' by the side of the neutral point, the coil of edge Wb ' by the side of this neutral point — a conductor — neutral point side edge child Tn It twists. Coil w1 - w4 of these 1st And 2nd coil w1 ' - w4 ' constitute the armature coil of W phase. after ending all the processes that wind the armature coil of U, V, and W3 phase — a coil — the coil which cut the conductor and was twisted around a neutral point side edge child and each \*\*\*\*\* side edge child — a conductor — each terminal — soldering — a coil — electrical installation of a conductor and each terminal is ensured.

[0019] in order to wind continuously all the armature coils of the three phase circuit by which star connection is carried out in the above-mentioned example — a coil — what is necessary is to perform only once the process which cuts a conductor in the place which winding of the armature coil of all phases ended moreover, the case of the armature coil of a three phase circuit — a coil — what is necessary is to perform the process which twists a conductor around a terminal only 7 times

[0020] in addition, the coil of the neutral point side edge section of the 1st coil of the armature coil of the phase which prepares only one neutral point side edge child, and winds him first in the above-mentioned example — with a conductor the coil of the neutral point side edge section of the 2nd coil of the armature coil of all phases — a conductor — all — this, although it was made to twist around one neutral point side edge child the neutral point side edge child [ two or more (for example, three pieces) ] each other connected electrically — preparing — the coil of the neutral point side edge section of the coil of plurality [ terminals / these / two or more ] — a conductor is divided and you may make it twist

[0021] Drawing 3 shows the structure of the brush loess direct current motor of an outer rotor form as an example of the dynamo-electric machine constituted using the armature which has the armature coil obtained according to the above-mentioned example. In this drawing, 1 is the armature which comes to wind an armature coil 3 around an armature core 2, and three non-neutral point side edge children who do not illustrate with the neutral point side edge child 5 (it is equivalent to the above-mentioned Tn.) are being fixed to the terminal block 4 which consists of resin cast by the armature core 2 at one. The armature 1 is being fixed to boss section 6a prepared in the stator base 6. Flange 6b is prepared in the end side of the direction of an axis of the stator base 6, and the printed circuit board 7 is attached in this flange 6b. The printed circuit board 7 is equipped with the component part of the drive circuit which is not illustrated. The terminal by the side of the non-neutral point of an armature coil 3 is connected to the printed circuit of a printed circuit board 7 (not shown). 8 is a magnet rotator, this magnet rotator consists of what attached the permanent magnet field 10 in the inner circumference of the peripheral wall section of the cup-like rotator 9, and the revolving shaft 11 fixed in the center of the bottom wall section of a rotator 9 is supported by boss section 6a of a stator base by bearing 12 and 13.

[0022] although the armature coil of the three phase circuit by which star connection is carried out was taken for the example in the above-mentioned example — this invention — general — the armature of each phase — a coil can be equipped with the armature coil of  $n$  phase ( $n$  is two or more integers) constituted with the 1st coil and 2nd coil by which parallel connection is carried out, and can apply it to the approach of winding the armature coil for dynamo-electric machines with which star connection of the armature coil of these  $n$  phases is carried out. the case where the armature coil of  $n$  phase is wound by the approach of this invention — a coil — the count which performs the process which twists a conductor around a neutral point side edge child and a non-neutral point side edge child all comes out  $(2n+1)$ , and is good in a time.

[0023]

[Effect of the Invention] According to this invention, as mentioned above, the armature coil of each phase which consists of the 1st and 2nd coils the place which began to roll from the edge by the side of the neutral point of the 1st coil, and was wound to the edge by the side of the non-neutral point — a coil, since it shifts to the winding process of the 2nd coil and this 2nd coil was wound to the edge by the side of the neutral point, without cutting a conductor on the way — coming out — a coil — the armature coil of each phase can be wound without cutting a conductor, and the winding activity of an armature coil can be done well.

[0024] After performing the process which winds the armature coil of each phase according to invention indicated especially to claim 2, The armature coil of the following phase can be wound continuously, without cutting a conductor. a coil — and the coil of the edge by the side of the neutral point of the armature coil of each phase, and the edge by the side of the non-neutral point — since the count which performs the process which twists a conductor around a neutral point side edge child and a non-neutral point side edge child, respectively can be lessened, the winding working capacity of an armature coil can be raised sharply.

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DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]

[Drawing 1] It is a coil development view for explaining the winding approach of the example of this invention.

[Drawing 2] They are the schematics of the armature coil wound by the example of this invention.

[Drawing 3] It is the sectional view having shown an example of the dynamo-electric machine using the armature which has the armature coil obtained according to the example of drawing 1.

[Drawing 4] It is a coil development view for explaining the conventional winding approach.

[Drawing 5] They are the schematics of the armature coil wound by the approach of drawing 4.

[Description of Notations]

U1 -U4 The magnetic pole section of U phase

V1 - V4 The magnetic pole section of V phase

W1 -W4 The magnetic pole section of W phase

u1 -u4 Unit coil of the 1st coil of the armature coil of U phase

u1 ' - u4 ' Unit coil of the 2nd coil of the armature coil of U phase

v1 - v4 Unit coil of the 1st coil of the armature coil of V phase

v1 The unit coil of the 2nd coil of the armature coil of a '-v4'V phase

w1 -w4 Unit coil of the 1st coil of the armature coil of W phase

w1 ' - w4 ' Unit coil of the 2nd coil of the armature coil of W phase

Tu Non-neutral point side edge child of U phase

Tv Non-neutral point side edge child of V phase

Tw Non-neutral point side edge child of W phase

Tn Neutral point side edge child

1 Armature

2 Armature Core

3 Armature Coil

5 Neutral Point Side Edge Child

8 Magnet Rotator

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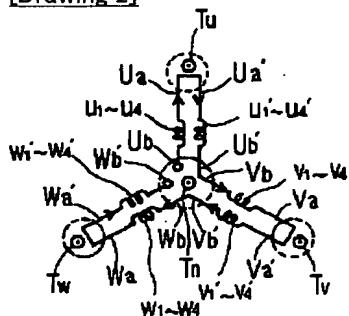
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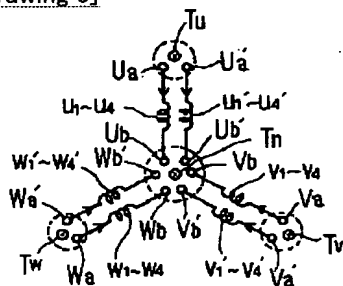
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## DRAWINGS

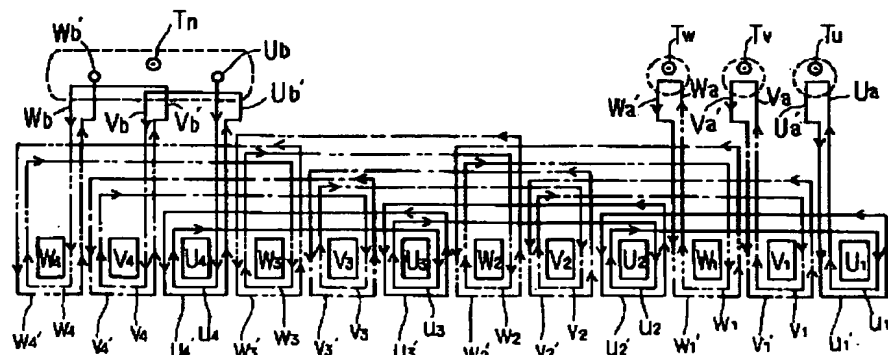
[Drawing 2]



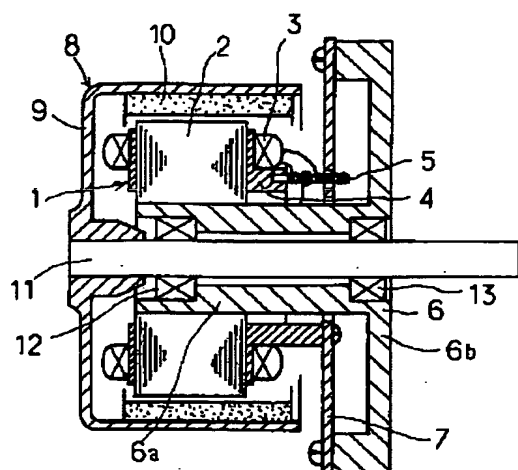
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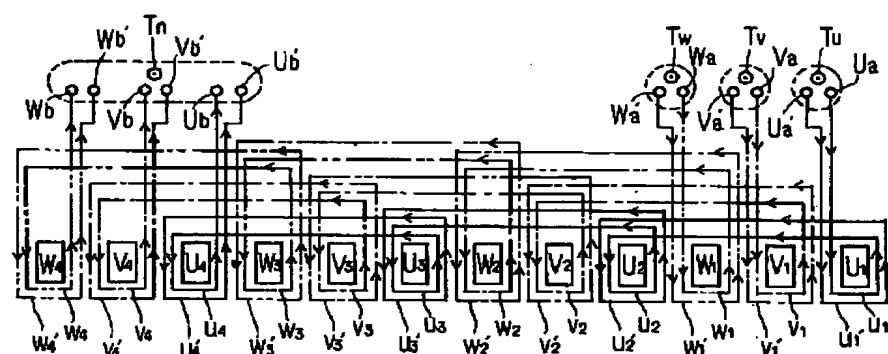
[Drawing 1]



[Drawing 3]



[Drawing 4]



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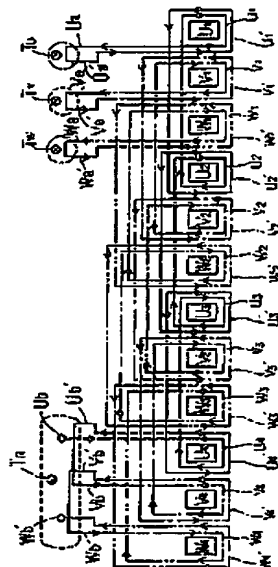
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(54) 【発明の名称】 回転電機の電機子コイル巻回方法

(57) 【要約】

【目的】 各相のコイルが互いに並列接続される2つのコイルからなる多相の電機子コイルを能率よく巻回できる回転電機の電機子コイル巻回方法を提供する。

【構成】 第1のコイル及び第2のコイルからなるU相の電機子コイルを巻回する工程で、先ずU相の電機子コイルの中性点側の端部U<sub>b</sub>を巻き始め端部として、所定のスロットをたどりながらU相に割り当てられた磁極部U<sub>4</sub>、U<sub>3</sub>、U<sub>2</sub>、U<sub>1</sub>に順次単位コイルu<sub>4</sub>、u<sub>3</sub>、u<sub>2</sub>、u<sub>1</sub>を巻回してU相の第1のコイルを非中性点側の端部U<sub>a</sub>まで巻回した後、この第1のコイルを巻回する際にたどったスロットを逆にたどりながら順に単位コイルu<sub>1</sub>'～u<sub>4</sub>'を巻回してU相の第2のコイルをその中性点側の端部U<sub>b</sub>'まで巻回する。他の相の電機子コイルも同様の方法により途中でコイル導体を切断することなく連続的に巻回する。



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【特許請求の範囲】

【請求項1】 各相に割り当てられた磁極部を複数個ずつ有する多数の磁極部を周方向に間隔を開けて設けて、該多数の磁極部相互間にそれぞれ形成された溝をコイル導体挿入用のスロットとした電機子鉄心を用い、各相に割り当てられた複数の磁極部に順次単位コイルを巻回して各相の電機子コイルを構成する工程を繰り返すことにより、星形結線される多相の電機子コイルを巻回する回転電機の電機子コイル巻回方法であって、

各相の電機子コイルは互いに並列に接続される第1のコイル及び第2のコイルにより構成するものとし、

各相の電機子コイルを構成する工程では、各相の電機子コイルの中性点側の端部を巻き始め端部として、所定のスロットをたどりながら各相に割り当てられた複数の磁極部に順次単位コイルを巻回して各相の第1のコイルを非中性点側の端部まで巻回する工程を行った後、コイル導体を切断することなく該第1のコイルを巻回する際にたどったスロットを逆にたどりながら順次単位コイルを巻回して各相の第2のコイルをその中性点側の端部まで巻回する工程を行うことを特徴とする回転電機の電機子コイル巻回方法、

【請求項2】 各相に割り当てられた磁極部を複数個ずつ有する多数の磁極部を周方向に間隔を開けて設けて、該多数の磁極部相互間にそれぞれ形成された溝をコイル導体挿入用のスロットとした電機子鉄心を用い、各相に割り当てられた複数の磁極部に順次単位コイルを巻回して各相の電機子コイルを構成する工程を繰り返すことにより、星形結線される多相の電機子コイルを巻回する回転電機の電機子コイル巻回方法であって、

各相の電機子コイルは互いに並列に接続される第1のコイル及び第2のコイルにより構成するものとし、

各相の電機子コイルを構成する工程では、各相の電機子コイルの中性点側の端部を巻き始め端部として、所定のスロットをたどりながら各相に割り当てられた複数の磁極部に順次単位コイルを巻回することにより各相の第1のコイルを非中性点側の端部まで巻回する工程を行った後、コイル導体を切断することなく該第1のコイルを巻回する際にたどったスロットを逆にたどりながら順次単位コイルを巻回して各相の第2のコイルを中性点側の端部まで巻回する工程を行い、

各相の電機子コイルの第2のコイルを巻回する工程を行った後、次の相の電機子コイルの第1のコイルを巻回する工程に移行することにより、コイル導体を途中で切断することなく全ての相の電機子コイルを連続的に巻回することを特徴とする回転電機の電機子コイル巻回方法。

【発明の詳細な説明】

【0001】

【産業上の利用分野】 本発明は、電動機や発電機などの回転電機の多相の電機子コイルを巻回する方法に関するものである。

【0002】

【従来の技術】 電動機や発電機などの回転電機の多相の電機子コイルは、各相に割り当てられた磁極部を複数個ずつ有する多数の磁極部を周方向に間隔を開けて設けて該多数の磁極部相互間にそれぞれ形成された溝をコイル導体挿入用のスロットとした電機子鉄心を用い、各相に割り当てられた複数の磁極部に順次単位コイルを巻回して各相の電機子コイルを構成する工程を繰り返すことにより、星形結線される多相の電機子コイルを巻回するようになっている。そして、スロット内へのコイル導体の挿入とコイルの巻回作業とを容易にするため、各相の電機子コイルは互いに並列に接続される第1のコイルと第2のコイルとに分けて巻回する2本並列巻きとすることも多い。

【0003】 図4及び図5は、3相星形結線されるこの種の電機子コイルを巻回する場合に採用されていた従来の巻回方法を示したもので、図4は電機子コイルの巻線展開図、図5は結線図である。これらの図において、U1～U4、V1～V4及びW1～W4は、それぞれU相、V相及びW相に割り当てられた電機子鉄心の磁極部で、これらの磁極部相互間にコイル導体挿入用のスロットが形成されている。電機子鉄心には、例えば該鉄心に対して絶縁された状態で固定されたピンからなるU、V、W相の非中性点側端子Tu、Tv、Twと中性点側端子Tnとが設けられている。なお図4及び図5において、破線で囲まれた部分は電気的に互いに接続されていることを表わしている。

【0004】 U相の電機子コイルを巻回する工程では、まずコイル導体の巻き始め端部UaをU相の非中性点側端子Tuに巻き付けた後、磁極部U1、U2、U3及びU4に順次単位コイルu1、u2、u3及びu4を図示矢印方向に沿って連続して巻回し、巻き終り端部Ubを中性点側端子Tnに巻き付けたのちコイル導体を切断して、単位コイルu1-u2-u3-u4によりU相の第1のコイルを構成する。次に巻き始め端部Ua'を同じ非中性点側端子Tuに巻き付けたのち第1のコイルを巻回する際にたどったスロットを順次たどりながら磁極部U1、U2、U3及びU4に第2のコイルu1'-u2'-u3'-u4'を巻回して巻き終り端部Ub'を中性点側端子Tnに巻き付けたのちコイル導体を切断する。

【0005】 V相及びW相についても同様な工程を繰り返すことにより、それぞれV相及びW相の電機子コイルが巻回される。即ち、V相については、巻き始め端部Va、Va'が非中性点側端子Tvに巻き付けられ、磁極部V1、V2、V3及びV4に第1のコイルv1-v2-v3-v4及び第2のコイルv1'-v2'-v3'-v4'が巻回されてそれぞれの巻き終り端部Vb、Vb'が中性点側端子Tnに巻き付けられる。またW相については、巻き始め端部Wa、Wa'が非中性点側端子

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Twに巻き付けられ、磁極部W1、W2、W3及びW4に第1のコイルw1-w2-w3-w4及び第2のコイルw1'-w2'-w3'-w4'がそれぞれ巻回されて巻き終り端部wb、wb'が中性点側端子Tnに巻き付けられる。

【0006】

【発明が解決しようとする課題】互いに並列に接続される第1のコイル及び第2のコイルからなる各相の電機子コイルを星形結線した構成の多相の電機子コイルを巻回する従来の巻回方法では、各相の第1のコイル及び第2のコイルのそれぞれの巻き始め端部及び巻き終り端部をそれぞれ非中性点側端子及び中性点側端子に巻き付ける工程と、各巻き終り端部でコイル導体を切断する工程とが必要である。例えば上記のように3相星形結線される電機子コイルを巻回する場合には、第1のコイル及び第2のコイルの端部について、合計12回の巻き付けと6回の切断とを行なう必要がある。そのため、従来の電機子コイル巻回方法では、巻線の作業時間が長くなり、電機子コイルのコストが高くなるという問題があった。

【0007】本発明の目的は、コイル端部の端子への巻き付け工程の実行回数とコイル導体の切断工程の実行回数とを少なくして能率よく巻回作業を行うことができるようにした回転電機の電機子コイル巻回方法を提供することにある。

【0008】

【課題を解決するための手段】本発明は、各相に割り当てられた磁極部を複数個ずつ有する多数の磁極部を同方向に間隔を開けて設けて、該多数の磁極部相互間にそれぞれ形成された溝をコイル導体挿入用のスロットとした電機子鉄心を用い、各相に割り当てられた複数の磁極部に順次単位コイルを巻回して各相の電機子コイルを構成する工程を繰り返すことにより、星形結線される多相の電機子コイルを巻回する回転電機の電機子コイル巻回方法に係わるものであって、各相の電機子コイルは互いに並列に接続される第1のコイル及び第2のコイルにより構成されているものとする。

【0009】本発明においては、各相の電機子コイルを構成する工程で、各相の電機子コイルの中性点側の端部を巻き始め端部として、所定のスロットをたどりながら各相に割り当てられた複数の磁極部に順次単位コイルを巻回して各相の第1のコイルを非中性点側の端部まで巻回する工程を行った後、コイル導体を切断することなく該第1のコイルを巻回する際にたどったスロットを逆にたどりながら順次単位コイルを巻回して各相の第2のコイルをその中性点側の端部まで巻回する工程を行うことにより、途中でコイル導体を切断することなく各相の電機子コイルを連続的に巻回する。

【0010】本発明ではまた、上記の工程により各相の電機子コイルの第2のコイルを巻回する工程を行った後、コイル導体を切断することなく次の相の電機子コイ

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ルの第1のコイルを巻回する工程に移行することにより、コイル導体を途中で切断することなく全ての相の電機子コイルを連続的に巻回する。

【0011】

【作用】上記のように、各相の電機子コイルを、第1のコイルの中性点側の端部から巻き始めて非中性点側の端部まで巻回する行程を行った後、コイル導体を切断することなくそのまま第2のコイルの巻回工程に移行し、該第2のコイルを中性点側の端部まで巻回するようにすると、第1のコイルを巻回する工程から第2のコイルを巻回する工程に移行する際にコイル導体を切断する工程を行う必要がなくなるだけでなく、第1のコイル及び第2のコイルの非中性点側の端部は、コイル導体を非中性点側端子に1回巻き付けるだけで該端子に共通に接続することができる。

【0012】また、各相の電機子コイルの第2のコイルを巻回する工程を行った後、コイル導体を切断することなく次の相の電機子コイルの第1のコイルを巻回する工程に移行するようにすると、途中でコイル導体を切断することなく全ての相の電機子コイルを巻回することができるだけでなく、各相の電機子コイルの第2のコイルの中性点側の端部と次の相の電機子コイルの第1のコイルの中性点側の端部とを中性点側端子に1回巻き付けるだけで接続することができる。

【0013】このように本発明によれば、コイル導体を切断する工程の回数と、コイル導体を端子に巻き付ける工程の回数とを少なくすることができるため、電機子コイルの巻回に要する時間を短縮することができる。

【0014】

【実施例】図1及び図2は本発明の実施例を示したもので、図1は3相星形結線される電機子コイルに本発明の巻回方法を適用した場合の巻線展開図、図2はその結線図である。これらの図において、図3及び図4と同等の部分には同一の符号が付してあり、破線で囲む部分は電氣的に互いに接続されていることを表すものとする。

【0015】図1及び図2において、U相、V相及びW相の3相の電機子コイルは星形に結線されている。U相の電機子コイルは、電機子鉄心のU相に割り当てられた磁極部U1～U4にそれぞれ巻回された単位コイルu1～u4からなる第1のコイルと、同じ磁極部U1～U4にそれぞれ巻回された別の単位コイルu1'～u4'からなる第2のコイルとにより構成され、V相の電機子コイルは、V相に割り当てられた磁極部V1～V4にそれぞれ巻回された単位コイルv1～v4からなる第1のコイルと同じ磁極部V1～V4にそれぞれ巻回された別の単位コイルv1'～v4'からなる第2のコイルとにより構成されている。またW相の電機子コイルは、W相に割り当てられた磁極部W1～W4にそれぞれ巻回された単位コイルw1～w4からなる第1のコイルと、同じ磁極部W1～W4にそれぞれ巻回された別の単位コイルw

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1' ~ w4' からなる第2のコイルとにより構成されている。電機子鉄心の各相に割り当てられた磁極部はU1, V1, W1, U2, V2, W2, U3, V3, W3, U4, V4, W4 の順で周方向に等間隔を開けて並ぶように配置され、これらの磁極部相互間にそれぞれ形成された溝がコイル導体挿入用スロットとして用いられている。

【0016】本実施例の巻回方法では、先ずU相の電機子コイルの第1のコイルの中性点側の端部Ub を中性点側端子Tn に巻き付け、該中性点側の端部Ub を巻き始め端部として、図示の矢印方向に沿って所定のスロットをたどりながらU相に割り当てられた磁極部U4, U3, U2 及びU1 に順次単位コイルu4, u3, u2 及びu1 を巻回してU相の第1のコイルを非中性点側の端部Ua まで巻回する工程を行い、該非中性点側の端部Ua のコイル導体を非中性点側端子Tu に巻き付ける。その後非中性点側端部でコイル導体を切断することなく折り返して、折り返した部分を第2のコイルの巻き始め端部Ua' とし、第1のコイルを巻回する際にたどったスロットを逆にたどりながら、U相の磁極部U1, U2, U3 及びU4 に順次単位コイルu1', u2', u3', 及びu4' を巻回してU相の第2のコイルを中性点側の端部Ub' まで巻回する工程を行って、該中性点側端部Ub' のコイル導体を中性点側端子Tn に巻き付ける。これら第1のコイルu1 ~ u4 と第2のコイルu1' ~ u4' とによりU相の電機子コイルを構成する。

【0017】U相の電機子コイルの第2のコイルを巻回する工程を終った後、コイル導体を切断することなく連続して次のV相の電機子コイルの第1のコイルを巻回する工程に移行する。V相の電機子コイルの第1のコイルを巻回する行程では、U相の電機子コイルの中性点側の端部Ub から折り返した部分を巻き始め端部Vb' とし、所定のスロットをたどりながらV相に割り当てられた磁極部V4, V3, V2 及びV1 に順次単位コイルv4, v3, v2 及びv1 を巻回してV相の第1のコイルを非中性点側の端部Va まで巻回する工程を行った後、該非中性点側端部Va のコイル導体を非中性点側端子Tv に巻き付ける。続いてコイル導体を切断することなく折り返して折り返した部分を第2のコイルの巻き始め端部Va' とし、第1のコイルを巻回する際にたどったスロットを逆にたどりながら、V相の磁極部V1, V2, V3 及びV4 に順次単位コイルv1', v2', v3' 及びv4' を巻回してV相の電機子コイルの第2のコイルを中性点側の端部Vb' まで巻回する工程を行った後、該中性点側端部Vb' のコイル導体を中性点側の端子Tn に巻き付ける。これら第1のコイルv1 ~ v4 及び第2のコイルv1' ~ v4' によりV相の電機子コイルを構成する。

【0018】V相の電機子コイルの第2のコイルを巻回する工程を終った後、コイル導体を切断することなく連

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続して次のW相の電機子コイルの第1のコイルを巻回する工程に移行する。W相の電機子コイルの第1のコイルを巻回する行程では、V相の電機子コイルの中性点側端部Vb' から折り返した部分を巻き始め端部Wb' とし、所定のスロットをたどりながらW相に割り当てられた磁極部W4, W3, W2 及びW1 に順次単位コイルw4, w3, w2 及びw1 を巻回してW相の第1のコイルを非中性点側の端部Wa まで巻回する工程を行った後、該端部Wa のコイル導体を非中性点側端子Tw に巻き付ける。続いてコイル導体を切断することなく折り返して折り返した部分を巻き始め端部Wa' とし、第1のコイルを巻回する際にたどったスロットを逆にたどりながら、W相の磁極部W1, W2, W3 及びW4 に順次単位コイルw1', w2', w3' 及びw4' を巻回してW相の電機子コイルの第2のコイルを中性点側の端部Wb' まで巻回する工程を行った後、該中性点側の端部Wb' のコイル導体を中性点側端子Tn に巻き付ける。これら第1のコイルw1 ~ w4 及び第2のコイルw1' ~ w4' によりW相の電機子コイルを構成する。U, V, W 3相の電機子コイルを巻回する工程を全て終了した後にコイル導体を切断し、中性点側端子及び各非中性点側端子に巻き付けられたコイル導体をそれぞれの端子に半田付けしてコイル導体と各端子との電気的接続を確実にする。

【0019】上記の実施例では、星形結線される3相の電機子コイルを全て連続的に巻回するため、コイル導体を切断する工程は、全ての相の電機子コイルの巻回が終了したところで1回だけ行えばよい。また3相の電機子コイルの場合、コイル導体を端子に巻き付ける工程は7回だけ行えばよい。

【0020】なお、上記の実施例では、中性点側端子を1個だけ設けて、最初に巻回する相の電機子コイルの第1のコイルの中性点側端部のコイル導体と、全ての相の電機子コイルの第2のコイルの中性点側端部のコイル導体とを全て該1個の中性点側端子に巻き付けるようにしたが、互いに電気的に接続された複数個（例えば3個）の中性点側端子を設けて、該複数個の端子に複数のコイルの中性点側端部のコイル導体を分けて巻き付けるようにしてもよい。

【0021】図3は、上記実施例により得られた電機子コイルを有する電機子を用いて構成された回転電機の一例として、アウターロータ形のブラシレス直流電動機の構造を示したものである。同図において、1は電機子鉄心2に電機子コイル3が巻回されてなる電機子で、電機子鉄心2に一体に成型された歯隙からなる端子台4に中性点側端子5（前述のTn に相当する。）と図示しない3個の非中性点側端子とが固定されている。電機子1は固定子台6に設けられたボス部6aに固定されている。固定子台6の軸線方向の一端側にはフランジ部6bが設けられていて、該フランジ部6bにプリント基板7が取

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り付けられている。プリント基板7には図示しない駆動回路の構成部品が装着されている。電磁子コイル3の非中性点側の端子はプリント基板7のプリント回路に接続されている（図示せず）。8は磁石回転子で、該磁石回転子はカップ状の回転子9の周壁部の内周に永久磁石界磁10を取り付けたものからなり、回転子9の底壁部の中央に固定された回転軸11が軸受12及び13により固定子台のボス部6aに支持されている。

【0022】上記の実施例では、星形結線される3相の電磁子コイルを例にとったが、本発明は、一般に各相の電磁子コイルは互いに並列接続される第1のコイル及び第2のコイルにより構成されるn相（nは2以上の整数）の電磁子コイルを備えて、該n相の電磁子コイルが星形結線される回転電機用電磁子コイルを巻回する方法に適用することができる。本発明の方法により、n相の電磁子コイルを巻回する場合、コイル導体を中性点側端子及び非中性点側端子に巻き付ける工程を行う回数は全部で $(2n+1)$ 回でよい。

【0023】

【発明の効果】以上のように、本発明によれば、第1及び第2のコイルからなる各相の電磁子コイルを、第1のコイルの中性点側の端子から巻き始めて非中性点側の端子まで巻回したところでコイル導体を切断することなく第2のコイルの巻回工程に移行し、該第2のコイルを中性点側の端子まで巻回するようにしたので、途中でコイル導体を切断することなく各相の電磁子コイルを巻回することができる。電磁子コイルの巻回作業を能率よく行うことができる。

【0024】特に請求項2に記載した発明によれば、各相の電磁子コイルを巻回する工程を行った後、コイル導体を切断することなく次の相の電磁子コイルを連続的に巻回することができ、しかも、各相の電磁子コイルの中性点側の端子及び非中性点側の端子のコイル導体をそれぞれ中性点側端子及び非中性点側端子に巻き付ける工程を行う回数を少なくすることができるため、電磁子コイルの巻回作業能率を大幅に向上させることができる。

【図面の簡単な説明】

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\*【図1】本発明の実施例の巻回方法を説明するための巻線展開図である。

【図2】本発明の実施例により巻回された電磁子コイルの結線図である。

【図3】図1の実施例により得られた電磁子コイルを有する電磁子を用いた回転電機の一例を示した断面図である。

【図4】従来の巻回方法を説明するための巻線展開図である。

10 【図5】図4の方法により巻回された電磁子コイルの結線図である。

【符号の説明】

U1～U4 U相の遊極部

V1～V4 V相の遊極部

W1～W4 W相の遊極部

u1～u4 U相の電磁子コイルの第1のコイルの単位コイル

u1'～u4' U相の電磁子コイルの第2のコイルの単位コイル

20 v1～v4 V相の電磁子コイルの第1のコイルの単位コイル

v1'～v4' V相の電磁子コイルの第2のコイルの単位コイル

w1～w4 W相の電磁子コイルの第1のコイルの単位コイル

w1'～w4' W相の電磁子コイルの第2のコイルの単位コイル

Tu U相の非中性点側端子

Tv V相の非中性点側端子

30 Tw W相の非中性点側端子

Tn 中性点側端子

1 電磁子

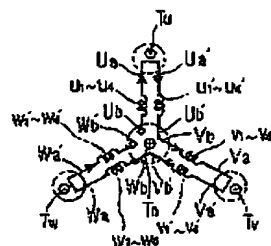
2 電磁子鉄心

3 電磁子コイル

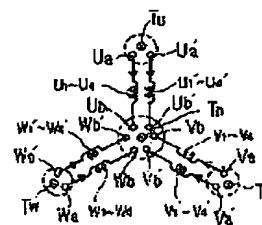
5 中性点側端子

8 磁石回転子

【図2】



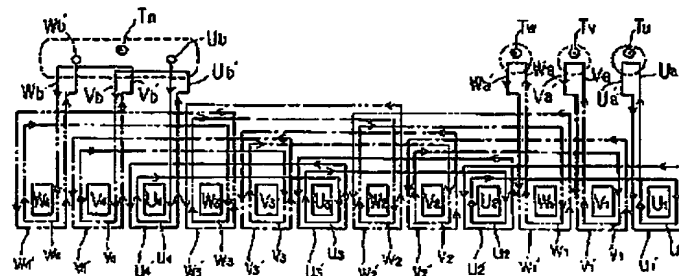
【図5】



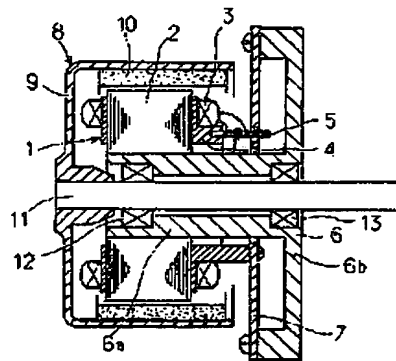
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【図1】



【図3】



【図4】

